WHAT IS CLAIMED IS:

1. An optical disk device comprising:

an optical pickup that records information on an optical disk or reproduces information from the optical disk, the optical disk being attached to the optical disk device;

a tilt sensor that is provided on the optical pickup and detects inclination of the optical disk in terms of a radial direction of the optical disk;

a tilt detection circuit that detects an output of the tilt sensor;

an objective lens that is provided on the optical pickup and focuses laser light on the optical disk;

tilt driving means for inclining the objective lens in terms of the radial direction by an amount corresponding to a driving signal;

a tilt driving circuit that applies the

driving signal to the tilt driving means based on a control signal;

tilt control means for providing the control signal to the tilt driving circuit based on an output of the tilt detection circuit;

reference tilt value storing means for storing a reference output of the tilt detection circuit as a reference tilt value, the reference output of the tilt detection circuit being based on a reference optical disk having a warping amount equal to or smaller than a predetermined value;

reference control value storing means for storing as a reference control value a reference control signal corresponding to a reference driving inclining amount in which inclining the objective lens by the reference driving inclining amount minimizes or reduces inclination of the objective lens relative to the reference optical disk;

wherein the tilt control means is adapted to provide the control signal to the tilt driving circuit, wherein the control signal is determined by multiplying a difference between the output of the tilt detection circuit and the reference tilt value by a predetermined control constant, and adding the reference control value to the multiplied difference.

2. The optical disk device according to claim 1, wherein to the tilt driving circuit, the tilt control means provide $Y=k \times (X-X0)+Y0$ as the control signal, X being the output of the tilt detection circuit, X0 being the reference tilt value, Y0 being the reference control value, k being the predetermined control constant.

3. The optical disk device according to claim 1, wherein to obtain the reference driving inclining amount, tilt driving means incline the objective lens N number of times by respective different inclining amounts, and the tilt control means calculates an expected highest reproducing signal level based on N number of data points that include the respective inclining amounts and respective reproducing signal levels generated by the

different inclining amounts, the expected highest reproducing signal level being determined as the reference driving inclining amount.

4. The optical disk device according to claim 1, further comprising:

adjustment tilt value storing means for storing as a second reference tilt value a second reference output of the tilt detection circuit being based on a second reference optical disk having a warping amount larger than the predetermined value; and

adjustment control value storing means for storing as a second reference control value a second reference control signal corresponding to the second reference driving inclining amount in which inclining the objective lens by the second reference driving inclining amount minimizes or reduces inclination of the objective lens relative to the second reference optical disk,

wherein the predetermined control constant is determined based on a difference between the

second reference tilt value and the reference tilt value, and a difference between the second reference control value and the reference control value.

5. The optical disk device according to claim 4, wherein the control constant is: $k=(B-Y0)/(A-X0)$ where A is the second reference tilt value, and B is the second reference control value.

6. The optical disk device according to claim 4, wherein if the output of the tilt detection circuit is larger than a predetermined value when attaching the optical disk, the output of the tilt detection circuit is stored as a new second reference tilt value in the adjustment tilt value storing means, the adjustment control value storing means store as a new second reference control value a new second reference control signal corresponding to a new second reference driving inclining amount in which

inclining the objective lens by the new second reference driving inclining amount minimizes or reduces inclination of the objective lens relative to the optical disk.

7. The optical disk device according to claim 1, further comprising constant storing means for storing the control constant that is based on a difference between a second reference tilt value and the reference tilt value, and difference between a second reference control value and the reference control value,

the second reference tilt value corresponding to a second reference output of the tilt detection circuit being based on a second reference optical disk having a warping amount larger than the predetermined value,

the second reference control value corresponding to a second reference driving inclining amount in which inclining the objective lens by the second reference driving inclining amount minimizes or reduces inclination of the objective lens relative

to the second reference optical disk.

8. The optical disk device according to claim 7, wherein if the output of the tilt detection circuit is larger than a predetermined value when attaching the optical disk, the constant storing means store as a new control constant a constant that is determined based on a difference between a new second reference tilt value and the reference tilt value, and a difference between a new second reference control value and the reference control value,

the new second reference tilt value corresponding to the output of the tilt detection circuit being based on the optical disk,

the new second reference control value corresponding to a new second reference driving inclining amount in which inclining the objective lens by the new second reference driving inclining amount minimizes or reduces inclination of the objective lens relative to the optical disk.

9. An optical disk device comprising:

an optical pickup that writes information on an optical disk, or reproduces information from the optical disk, the optical disk being attached to the optical disk device;

a tilt sensor that is provided on the optical pickup, and detects inclination of the optical disk;

a tilt detection circuit that detects an output of the tilt sensor;

an objective lens that is provided on the optical pickup, and focuses laser light on the optical disk;

tilt driving means for inclining the objective lens by an amount corresponding to a driving signal in terms of a radial direction of the optical disk;

a tilt driving circuit that applies the driving signal to the tilt driving means, based on a control signal; and

tilt control means for providing the control signal to the tilt driving circuit, based on an

output of the tilt detection circuit,

wherein a reference output of the tilt detection circuit is set as a reference tilt detection value, the reference output being based on an inner side radial position of a reference optical disk having a warping amount that changes from the inner side radial position to an outer side radial position of the reference optical disk.

a reference control signal is set as a reference control value, the reference control signal corresponding to a reference driving inclining amount in which inclining the objective lens by the reference driving inclining amount minimizes or reduces inclination of the objective lens relative to the reference optical disk at the inner side radial position,

a second reference output of the tilt detection circuit is set as a second reference tilt detection value, the second reference output being based on the outer side radial position of the reference optical disk,

a second reference control signal is set as a second reference control value, the second reference control signal corresponding to a second reference driving inclining amount in which inclining

the objective lens by the second reference driving inclining amount minimizes or reduces inclination of the objective lens relative to the reference optical disk at the outer side radial position,

the optical disk device further comprises tilt relation storing means for storing the reference tilt value, the second reference tilt value, the reference control value and the second reference control value, or storing constants that represent relation between the output of the tilt detection circuit and the control signal, the constants being calculated based on the reference tilt value, the second reference tilt value, the reference control value and the second reference control value,

and the tilt control means calculate the control signal based on the output of the tilt detection circuit by using the information stored in the tilt relation storing means.

10. The optical disk device according to claim 9, wherein the tilt control signal has information of Y:

$Y=k'' \times X+X0'$,

where $k''=(B2-B1)/(A2-A1)$, and $X0'=(-A1 \times B2+A2 \times B1)/(A2-A1)$, A1 is the reference tilt value, A2 is the second reference tilt value, B1 is the reference control value, and B2 is the second reference control value.

11. The optical disk device according to claim 9, wherein when a change of the output of the tilt detection circuit from an inner side radial position to an outer side radial position of the optical disk is larger than a predetermined value, a new reference output of the tilt detection circuit is set as a new reference tilt detection value, the new reference output being based on a reference radial position on the optical disk where the new reference output is small,

a new reference control signal is set as a new reference control value, the new reference control signal corresponding to a new reference driving inclining amount in which inclining the objective lens by the new reference driving inclining

amount minimizes or reduces inclination of the objective lens relative to the optical disk at the reference radial position,

a new second reference output of the tilt detection circuit is set as a new second reference tilt detection value, the new second reference output being based on a second reference radial position on the optical disk where the new second reference output is large,

a new second reference control signal is set as a new second reference control value, the new second reference control signal corresponding to a new second reference driving inclining amount in which inclining the objective lens by the new second reference driving inclining amount minimizes or reduces inclination of the objective lens relative to the optical disk at the second reference radial position,

and the tilt relation storing means store the new reference tilt value, the new second reference tilt value, the new reference control value, and the new second reference control value, or store new constants that represent relation between the output of the tilt detection circuit and the control signal, the new constants being calculated based on

the new reference tilt value, the new second reference tilt value, the new reference control value, and the new second reference control value.

12. A method of performing tilt adjustment of an objective lens relative to an optical disk, comprising the steps of:

attaching to an optical disk device a reference optical disk in which a warping amount of the reference optical disk is equal to or smaller than a predetermined value;

detecting a reference inclination amount of the reference optical disk in terms of a radial direction of the reference optical disk;

obtaining a reference driving inclining amount in which inclining the objective lens by the reference driving inclining amount minimizes or reduces inclination of the objective lens relative to the reference optical disk;

storing the reference inclination amount as a reference tilt value, and storing the reference driving inclining amount as a reference control

value;

removing the reference optical disk from and attaching an object optical disk to the optical disk device;

detecting an object inclination amount of the object optical disk;

determining a target inclining amount based on the reference tilt value, the reference control value, and the object inclination amount; and

inclining the objective lens by the target inclining amount to perform tilt adjustment of the objective lens relative to the object optical disk.

13. The method according to claim 12, wherein the step of obtaining the reference driving inclining amount comprises the steps of:

(a) inclining the objective lens by a predetermined inclining amount;

(b) detecting a reproducing signal level generated by the optical pickup in a state where the objective lens is inclined by the predetermined inclining amount;

(c) repeating the steps (a) and (b) N number of times to obtain the N number of data points, wherein the predetermined inclining amounts of the respective N number of times of the step (a) are different from each other;

(d) determining an expected highest reproducing signal level based on the N number of data points; and

(e) determining the expected highest signal level as the reference driving inclining amount.

14. The method according to claim 13, wherein the step of obtaining the reference driving inclining amount further comprises the steps of:

determining a quadratic curve that approximately represents relation between the predetermined inclining amount and the reproducing signal level, based on the N number of data points; and

determining the expected highest signal level based on the determined quadratic curve.

15. The method according to claim 12, further comprising the steps of:

attaching to the optical disk device a second reference optical disk in which a warping amount of the second reference optical disk is larger than the predetermined value;

detecting a second reference inclination amount of the second reference optical disk in terms of a radial direction of the second reference optical disk;

obtaining a second reference driving inclining amount in which inclining the objective lens by the second reference driving inclining amount minimizes or reduces inclination of the objective lens relative to the second reference optical disk;

storing the second reference inclination amount as a second reference tilt value, and the second reference driving inclining amount as a second reference control value; and

determining the target inclining amount further based on the second reference tilt value and the second reference control value.

16. The method according to claim 12, further comprising the steps of:

attaching to the optical disk device, a second reference optical disk in which a warping amount of the second reference optical disk is larger than the predetermined value;

detecting a second inclination amount of the objective lens in terms of a radial direction of the second reference optical disk;

obtaining a second reference driving inclining amount in which inclining the objective lens by the second reference driving inclining amount minimizes or reduces inclination of the objective lens relative to the second reference optical disk;

calculating a control constant based on a difference between the second reference inclination amount and the reference tilt value, and a difference between the second reference driving inclining amount and the reference control value; and

determining the target inclining amount by using the determined control constant.

17. The method according to claim 16, wherein the step of obtaining the second reference driving inclining amount comprises the steps of:

(a) inclining the objective lens by a predetermined inclining amount;

(b) detecting a reproducing signal level generated by an optical pickup in a state where the objective lens is inclined by the predetermined inclining amount;

(c) repeating the steps (a) and (b) N number of times to obtain N number of data points, wherein the predetermined inclining amounts of the respective N number of times of the step (a) are different from each other;

(d) determining an expected highest reproducing signal level based on the N number of data points; and

(e) determining the expected highest signal level as the second reference driving inclining amount.

18. The method according to claim 17, wherein the step of obtaining the second reference driving inclining amount further comprises the steps of:

determining a quadratic curve that approximately represents relation between the predetermined inclining amount and the reproducing signal level, based on the N number of data points; and

determining the expected highest signal level based on the determined quadratic curve.

19. A method of performing tilt adjustment of an objective lens relative to an optical disk, comprising the steps of:

attaching to an optical disk device a reference optical disk in which a warping amount of the reference optical disk changes from an inner side to an outer side of the reference optical disk;

detecting a reference inclination amount of the reference optical disk at the inner side in terms of a radial direction of the reference optical disk;

obtaining a reference driving inclining amount in which inclining the objective lens by the reference driving inclining amount minimizes or reduces inclination of the objective lens relative to the reference optical disk at the inner side;

detecting a second reference inclination amount of the reference optical disk at the outer side in terms of the radial direction of the reference optical disk;

obtaining a second reference driving inclining amount in which inclining the objective lens by the second reference driving inclining amount minimizes or reduces inclination of the objective lens relative to the reference optical disk at the outer side;

removing the reference optical disk from and attaching an object optical disk to the optical disk device;

detecting an object inclination amount of the object optical disk;

determining a target inclining amount based on the object inclination amount, the reference

inclination amount, the second reference inclination amount, the reference driving inclining amount, and the second reference driving inclining amount; and

inclining the objective lens by the target inclining amount to perform tilt adjustment of the objective lens relative to the object optical disk.

20. The method according to claim 19, wherein the target inclining amount is Y:

$Y=k'' \times X+X0'$,

where $k''=(B2-B1)/(A2-A1)$, and $X0'=(-A1 \times B2+A2 \times B1)/(A2-A1)$, A1 is the reference inclination amount, A2 is the second reference inclination amount, B1 is the reference driving inclining amount, B2 is the second reference driving inclining amount, and X is the object inclination amount.

21. The method according to claim 20, further comprising the step of storing the values k'' and X0' in a memory.

22. An optical disk device, comprising:

an optical pickup that records information on an optical disk or reproduces information from the optical disk;

a tilt sensor that detects inclination of the optical disk in terms of a radial direction of the optical disk;

an objective lens supported by the optical pickup to perform said information recording and reproducing;

a tilt adjustment mechanism for inclining the objective lens in terms of the radial direction based a driving signal;

a tilt driving circuit that applies the driving signal to the tilt adjustment mechanism based on a control signal;

a tilt detection circuit that generates a tilt detection result based on the inclination detected by the tilt sensor, wherein the tilt detection result constitutes a reference tilt value when the optical disk is a reference optical disk

having a warping amount equal to or smaller than a predetermined value, and wherein the tilt detection result constitutes an object inclination amount when the optical disk is an object optical disk;

a memory that stores the reference tilt value;

a CPU for providing the control signal to the tilt driving circuit, wherein the control signal for adjusting relative inclination between the objective lens and the object optical disk is determined by:

$$Y = k \times (X - X0)$$

wherein Y is the control signal, X is the object inclination amount, X0 is the reference tilt value, and k is a predetermined control constant.

23. The optical disk according to claim 22, wherein the memory stores as a reference control value a reference control signal corresponding to a reference driving inclining amount in which inclining the objective lens by the reference driving inclining amount minimizes or reduces inclination of the

objective lens relative to the reference optical disk, and wherein the control signal for adjusting relative inclination between the objective lens and the object optical disk is modified according to:

$$Y = k \times (X - X0) + Y0$$

wherein Y0 is the reference control value.

24. The optical disk device according to claim 23, wherein the tilt sensor and the objective lens are separately provided on the optical pickup such that the inclination of the optical disk detected by the tilt sensor is not affected by inclining the objective lens.

25. The optical disk device according to claim 23, further comprising a spindle motor that rotates the optical disk, wherein when the tilt sensor detects the inclination of the optical disk, the spindle motor rotates the optical disk.

26. An optical disk device, comprising:

an optical pickup that records information on an optical disk or reproduces information from the optical disk;

a tilt sensor that is provided on the optical pickup and detects inclination of the optical disk in terms of a radial direction of the optical disk;

a tilt detection circuit that detects an output of the tilt sensor;

an objective lens that is provided on the optical pickup for information recording or reproducing;

tilt driving means for inclining the objective lens in terms of the radial direction, based on a driving signal;

a tilt driving circuit that applies the driving signal to the tilt driving means based on a control signal;

tilt control means for providing the control

signal to the tilt driving circuit based on an output of the tilt detection circuit;

reference tilt value storing means for storing a reference output of the tilt detection circuit as a reference tilt value, the reference output of the tilt detection circuit being based on a reference optical disk having a warping amount equal to or smaller than a predetermined value;

reference control value storing means for storing as a reference control value a reference control signal corresponding to a reference driving inclining amount in which inclining the objective lens by the reference driving inclining amount reduces inclination of the objective lens relative to the reference optical disk;

wherein the tilt control means is adapted to determine, for adjusting inclination of the objective lens relative to an object optical disk, a target inclining amount by which the objective lens may be tilted relative to the object optical disk, and wherein the target inclining amount is based on the reference tilt value, the reference control value, and an object output of the tilt detection circuit corresponding to the object optical disk.